Huntsville Engineering and Support Center

US ARMY CORPS of ENGINEERS

ELECTRONIC TECHNOLOGY SYSTEMS CENTER

Unmatched experience and technical expertise make Huntsville Center the recognized leader for electronic systems

Volume 2, Issue 2

ESS SECURITY SURVEYS

It seems that all organizations, public and private alike, are reviewing the security posture of their individual facilities as well as campuses as a whole. A necessary step in this process is a security site survey to define the foundational security requirements of the site and set the direction of the resultant project.

Security site surveys are often prompted by a variety of factors including construction of new facilities, initiation of a new program, or to respond to an increased threat. Very simply, regardless of the primary instigating factor, the main purpose of a site survey is to ensure that the security program currently in place provides an adequate level of protection to the specific assets and, if deficiencies are found, formulate steps to address the shortfalls. In other words:

- *Where is my security program now*?
- *Where should my security program be in five years*?
- *What steps do I need to take to get there*?
- *How much will it cost*?

In the case of a focused electronic security system (ESS) site survey, the primary functions would involve the electronic entry control system (EECS), the intrusion detection system (IDS) and the closed-circuit television (CCTV) system, specifically focusing on how they are applied to the facility or installation under review and how effective the application of these systems are in reducing the risk to the complex.

The mechanics of a security site survey are fairly straightforward. The details can get a little difficult, depending on the type of facility and mission, but essentially the following needs to be considered:

Description of the Facility and/or Site: A clear and concise understanding of the purpose of each facility and the integrated site. After all, the appropriate security posture of the facility, in large degree, is determined by its function.

Existing System: One of the major contributions a site survey makes to an existing program is documentation of an existing system. A comprehensive site survey should note the location of every major security component. This data is then used to evaluate the adequacy as well as the efficiency of the existing security system application.

Communications Infrastructure: The days of installing a dedicated communications infrastructure for a new security system are waning. While there will always be those special situations where a dedicated communications loop is justified, more and more systems are utilizing existing network-type communications systems for security purposes. A comprehensive site survey should document the configuration, availability, and capacity of any existing communications network.

Regulatory Requirements: In some instances, a site survey will be conducted in order to compare the existing security program against regulatory requirements. The survey team must have a thorough understanding of these requirements prior to initiation of the survey.

Availability of Power: As the general perception of threat increases, security systems are being extended to facilities once considered too remote to be of concern. With this shift comes real concern about reliable power and communications infrastructure.

Site Preparation Issues: The site survey should also be constantly looking for facility issues that will impede or preclude application of an ESS. An example would be poorly fitting or deteriorated doors that will demonstrate enough movement, even in the closed and locked position, to result in nuisance alarms from door monitoring contacts such as balanced magnetic switches. Also, at a high-risk facility calling for perimeter intrusion detection system, site terrain, fence condition, boundary-penetrating waterways and culverts become critical implementation issues.

One key aspect of the site survey that must be thoroughly discussed and explored with the site point of contact is the threat and vulnerabilities associated with the site. These two issues generally determine operational requirements and capabilities, which the site security system must fulfill. Some federal sites will have a current risk assessment that can be used to gauge the general threat to the site; however, additional considerations must be taken into account including current national and international events and the criticality of the site mission.

The end product of an ESS site survey normally includes the following information:

System Evaluation: The site survey report should in all cases include a written documentation of the condition of the existing ESS including all subsystems. This condition assessment should include an evaluation of the physical condition and operability of the system as well as a discussion of the efficiency of the system.

Upgrade Recommendations: As deficiencies are identified in either the condition or utilization of the existing ESS, upgrade recommendations must be made to rectify system shortcomings. This could range from a recommendation to completely replace an obsolete system that is no longer supported by the manufacturer to minor activities such as preventive maintenance and software upgrades.

Concept Level Drawings: A common finding of an ESS survey is that not all the critical areas or assets are provided appropriate protection by the system. In this case, the system must be expanded to include new assets or facilities or areas that were simply missed in the initial ESS implementation. Concept level drawings showing basic floor plans and the recommended location of recommended security components are often used to efficiently and definitively illustrate the upgrade recommendations presented in the text of the report.

Budgetary Cost Estimate: In many cases, each upgrade recommendation is accompanied with a budgetary cost estimate. This estimate must include not only the cost of the actual security equipment but the labor to install the equipment as well. A third item that must be included in the budgetary cost estimate is any site preparation work that must be performed in order to prepare the facility for effective implementation of ESS components. Typically this includes minor repair activities such as replacing broken or hollow-core doors when the criticality of the asset justifies the delay provided by either a metal or solid-core wooden door. At other times, site preparation could be more extensive, such as installation of an exterior lighting system to support a CCTV system.

The site survey provides a starting point for upgrading the security posture of a site. Because of this foundational role, the survey must be done carefully and thoroughly in order to properly scope and fund future activities. Obviously, it is during this crucial stage that the earliest formulation of functional requirements occurs that will provide the boundary conditions for any follow-on upgrades.

CONTROLLING MINIMUM OUTSIDE AIR CFM ON VARIABLE AIR VOLUME AIR HANDLING UNITS

ASHRAE Ventilation Standard 62-89 states, "5.4 When the supply of air is reduced during times the space is occupied (e.g., in variable-air-volume system), provision shall be made to maintain acceptable indoor air quality throughout the occupied zone."

This requirement is to ensure that during summer (non-economizer) operation, the outside air (OA) cfm does not fall as the supply fan reduces the total fan cubic feet per minute There are many ways to do this. This article discusses several ways to accomplish this.

The first method, shown in Figure 1, is to set the mixing dampers at the position required for design OA with the fan operating at design load (a test and balance function), and then control the return air damper to keep the mixing box (negative) static pressure constant so that, for a given OA damper minimum position, the OA cfm remains constant.

This procedure is simple:

1. Determine the mixing damper minimum open position necessary for the design OA cfm when the AHU is at design cfm (a test-and-balance task).

2. Note the mixing box static (negative) pressure at this condition.

3. During all non-economizer periods of occupation, set the dampers at the minimum position determined in Step 1 and maintain the static pressure noted in Step 2 by modulating the return dampers closed beyond the noted minimum position as the supply fan cfm reduces.

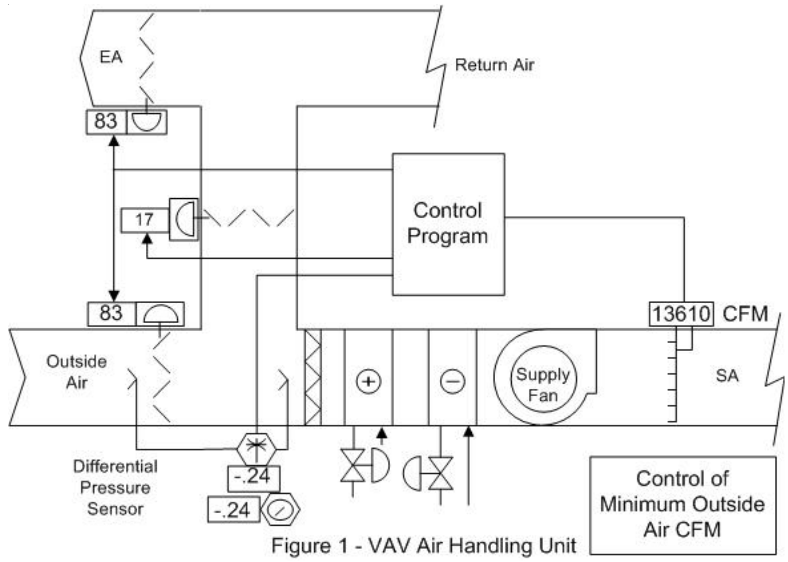

Figure 1 - VAV Air Handling Unit

Since the outside air damper must precisely position to the same position every time the occupied mode occurs during the non-economizer period, the OA damper must be well maintained, and if pneumatic actuation is used, pilot positioners are suggested. Good maintenance and positioners are also suggested for the return air damper as well, to assure smooth mixing box static pressure control.

Following is a typical sequence of operation for this scheme.

1. Ventilation Control: During scheduled occupied periods, the mixing dampers shall position to a minimum outside air ventilation position, and the exhaust fan shall start.

2. As the supply fan cfm reduces during periods of partial load in the non-economizer mode of operation, the return air dampers shall be modulated closed further as required to maintain a constant mixing box static pressure value (setpoint determined by the test and balance contractor).

3. Positive positioners shall be provided for all pneumatic mixing box damper actuators.

NOTE: To support the above sequence, the following spec should be inserted in the test and balance section:

The test and balance contractor shall determine the setpoint for the mixing box static pressure for each VAV AHU as follows:

1. Position all associated VAV boxes to their maximum cfm values.

2. Increment the VAV AHU mixing box damper minimum ventilation value until the design outside air cfm introduction is observed.

3. Note the mixing box (negative) static pressure at this condition, and provide this value to the DDC system contractor. (The DDC contractor will then enter this value as the setpoint for a mixing box static pressure control loop controlling the return dampers, so when the supply fan reduces during partial load, the pressure will not rise and cause less than design OA to be provided.)

The second method, shown in Figure 2, again requires test and balance work, but no additional hardware, if a supply fan flow element exists. As above, the VAV AHU is operated at its design cfm

SEE AHUS ON PAGE 3

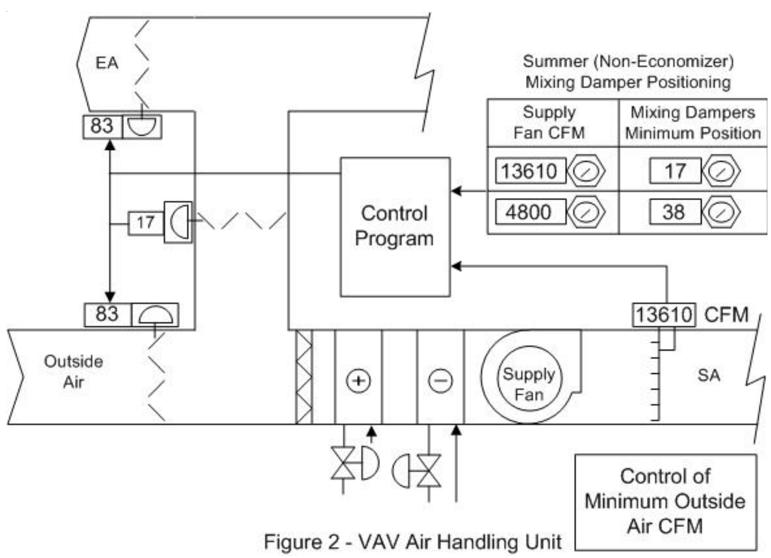

Figure 2 - VAV Air Handling Unit

OPTIMIZING THE OPTIMUM START PROGRAM

Background: When minicomputers were first introduced into HVAC control systems, one of the main features was an "Optimum Start Program" (OSP), whereby the computer would check the occupancy schedule, time of day, outside air temperature, and temperature of a typical perimeter area, and then calculate the latest time that the heating (or cooling) system could be started so that comfort conditions could be achieved at occupancy time. The OSP was designed to start the system with zero outside air and enable the ventilation dampers and exhaust fans some 15 minutes prior to the scheduled occupancy time.

These programs were an improvement over basic time-clock systems that always assumed design basic conditions. However, systems at that time were constant volume. When a fan or pump ran, it ran at one speed… full speed.

Today's systems are often variable volume; however, the OSP start-up sequence is usually the same as in the 60s, i.e., start equipment at full load as late as possible.

OSP with Variable Volume Systems: For this discussion, a building with variable air volume air handlers, dual chillers, and variable flow pumping is used.

On a warm morning, the 60s version of the OSP would start the fans as late as possible to have the building comfortable at occupancy time. The boxes would all be calling for maximum airflow, and the system would probably have a cooling demand beyond the design capacity because the east and west zones are at full load simultaneously, a condition beyond design. Similarly, the chillers and water flow demand is beyond design, and the design chilled water temperature will not be achieved until some of the VAV boxes get satisfied and start reducing air flow, thus delaying good dehumidification. By occupancy time, however, things will be comfortable, and the system will be accommodating the 0800 conditions easily, in mild weather, with only one chiller.

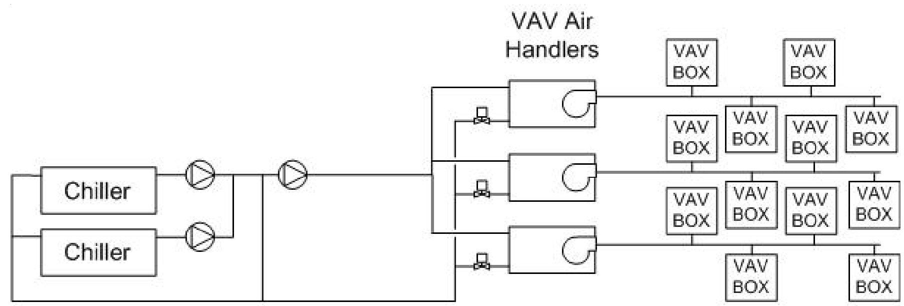

Figure 1 - Variable Flow System

Variable Flow Laws: Fan and pump laws state that (*for a given static system*), as flow reduces to 1/2, the system pressure drop falls to 1/4, and the motor horsepower drops to approximately 1/8. This follows the basic definition of horsepower: the mass of water (or air) per unit of time (GPM) times the lift (pressure increase). At half flow, the mass is half, but most HVAC variable flow systems do not allow the system pressure to fall. The pressure is wasted across throttling dampers (VAV boxes) or water valves. The variable flow HVAC systems cannot follow the variable flow laws if they allow dampers and valves to change the design static system by introducing resistance to flow. So, if pressure is controlled constant at the fan discharge at half flow, the horsepower is 1/2, not 1/8. If the pressure sensor is at the end of the line, and held constant, additional savings will be achieved as the trunk duct friction losses drop at reduced flows. If 1/2 flow is desired through a VAV box, 1/4 design pressure is required.

To address this problem for the variable flow systems in Figure 1, specify that during preoccupancy periods of op-

SEE OPTIMIZING PAGE 4

AHUS CONT. FROM PAGE 2

airflow, the mixing dampers are positioned until the design OA cfm is observed, and that position is noted (Position 17 in Figure 2). Then the VAV boxes are all set to operate at their minimum cfm, and the mixing dampers are again positioned until the design OA cfm is noted (Position 38 in Figure 2 example).

The specifications would require the following:

1. The test and balance contractor shall operate the supply fan at design loading (cfm 1) and position the mixing dampers (position 1) to allow the design cfm of OA to be introduced. The test and balance contractor shall then operate the supply fan at the system minimum cfm (cfm 2), and reposition the dampers (position 2) to allow the design cfm of OA to be introduced.

2. The controls contractor shall install a control program so during occupied non-economizer periods of operation, as the supply cfm varies from cfm 1 to cfm 2, the mixing dampers shall vary from position 1 to position 2.

3. If pneumatic damper actuators are used, pilot positioners shall be used for smooth and precise damper movement.

ETSC POINT OF CONTACT

PHONE: (256) 895-1740

Contact-ESC@hnd01.usace.army.mil

OPTIMIZING CONT. FROM PAGE 3

eration each VAV box "Maximum CFM" parameter is reduced to 45% of its design value, and returned to the design value 15 minutes before occupancy time. Also specify that the end-of-line static pressure control setpoint be set to 28% of the design value, and ramped back up to the design value from occupancy time minus 17 minutes to occupancy time minus 10 minutes. During these preoccupancy periods of operation, the VAV box dampers will be near open and taking a very small pressure drop. Each box should control at 45% of its design flow so that flow is even throughout the system and not unpredictable as it would be if we opened all the box dampers. In this mode of operation, the fan horsepower will be a little greater than 1/8 design, but the cool-down duration will be a little over twice as long. It should be noted here that with most of today's DDC systems, the OSP tuning factor is "adaptive", or self-tuning... it will automatically learn that it must start earlier than if the fan ran fully loaded.

Chiller Plant Implications: Since during the preoccupancy cool-down period, the cooling load is less than half, one chiller should be locked off until occupancy time.

Since the VAV Air Handling Unit (AHU) chilled water valves should be demanding approximately 50% of the design chilled water flow, the pumping horsepower required should be approximately 1/8 of design (½ mass times ¼ pressure drop). But, as noted above, the variable flow laws will not be valid if the water pressure is maintained at a constant value. For this pressure control loop, it is recommended that the water differential water pressure (DP) setpoint be set at 50% of design upon start-up, and reset from there dependent upon what the AHU chilled water valves are doing, i.e., if all AHU chilled water valves are less than 86% open, lower the DP setpoint 1 psi every 8 minutes; and if any AHU chilled water valve is full open, raise the DP setpoint 1 psi every 5 minutes. This generalized strategy should be modified dependent upon actual system configurations, the number and size of AHUs, the presence of balancing valves, the magnitude of the design DP, etc. All numbers noted herein should be specified to be keyboard adjustable from the UMCS console.

These control strategies result in significant energy and maintenance savings.